Kathryn Elsby Dissertation

by Kathryn Elsby

Submission date: 28-Aug-2019 10:21AM (UTC+0100)
Submission ID: 110318983
File name: 63621_Kathryn_Elsby_Kathryn_Elsby_Dissertation_1064857_263657989.pdf (1.73M)
Word count: 16618
Character count: 91175

UCL Bartlett School of Planning:

BPLN0008 Dissertation in City Planning / BPLN0039 Dissertation in Planning / BPLN0052 Major Research Project

To be completed by the student submitting the dissertation:

Candidate name:	Kathryn Elsby
Programme name:	MSc Transport and City Planning
Time and date due in:	2/9/2019, 17:00
Supervisor name:	Dr Astrid Wood

To be completed by the School office:

Time and date actually submitted:	
Lateness penalty applied (if applicable)**:**	
Supervisor name:	
Second marker name:	
Third marker name (if applicable):	

UNIVERSITY COLLEGE LONDON

FACULTY OF THE BUILT ENVIRONMENT

BARTLETT SCHOOL OF PLANNING

E-bikes in London: Perpetual Transport Niche or The Next Mainstream Mode?

Kathryn Elsby

Being a dissertation submitted to the faculty of The Built Environment as part of the requirements for the award of the Transport and City Planning MSc at University College London: I declare that this dissertation is entirely my own work and that ideas, data and images, as well as direct quotations, drawn from elsewhere are identified and referenced.

Signature: Kathryn Elsby

Date: 23/8/19

Word count (main body): 10,377

Word count (appendices): 1,637

“You never get to the end of a car journey and think ‘Wow - I’m really glad I did that.’”

- Interviewee nine

Acknowledgements

I would like to thank everyone who gave up their time to help with this research, particularly the 10 people who took part in the e-ride-alongs.

Sincere thanks also go to my supervisor Astrid Wood for challenging my thinking and pushing me to achieve my potential.

A special thank you to family and friends for their support, and for their patience during various e-bike-based discussions.

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List of Abbreviations

WHO	World Health Organisation
TfL	Transport for London
GLA	Greater London Authority
CO2	Carbon dioxide
HE	Highways England
MLP	Multi Level Perspective
UK	United Kingdom

DFT	Department for Transport
TPB	Theory of Planned Behaviour
PBC	Perceived Behavioural Control

Abstract

There is a growing global agenda for sustainable transport systems. The transport sector is the fastest growing contributor of CO^2 emissions, with 8.1 million tonnes emitted by transport in London annually. E-bikes are thought to be environmentally superior to other motorised modes of transport, and can expand the role of bikes by overcoming common barriers to traditional cycling such as time, distance and topography. However, e-bikes are still a niche market in London compared to elsewhere in Europe, and it is imperative that the reasons for this are understood to assess whether e-bikes can become a mainstream transport mode. Understanding this will have implications for transitions from carbon-intensive transport systems to sustainable ones. Framed by the multi-level perspective (MLP) within transition theory, an online survey and series of semi-structured interviews in the form of an innovative 'e-ride-along' were completed within a case study context. These methods sought to establish which factors affected travel mode choice, explore the attitudes and perceptions towards e-bikes of non e-bike users of different demographics, identify the main barriers to e-bike use in London, and understand whether attitudes towards e-bikes change after trying one for the first time. Results show that the main barriers to e-bike use in London are cost, safety, negative social stigma and lack of cycle infrastructure, and that these barriers are likely to be experienced differently depending on demographic characteristics. Results also show that habitual associations with unsustainable travel patterns could make the transition to sustainable transport modes such as e-bikes challenging. E-ride-along participants found the e-bike experience fun and enjoyable, with perceptions generally becoming more positive after riding one. In order for e-bikes to transition from a niche to a mainstream transport mode in London, a range of interventions may be required by both regime and niche actors.

Chapter 1: Introduction

1.1 A shift towards sustainable mobility

Contemporary environmental problems such as climate change present "formidable societal challenges" (Geels, 2011, page 4). There is growing interest in a global sustainability agenda, including the growth and implementation of sustainable mobilities and transport systems. At the forefront of this agenda is the number of "intractable problems" associated with a car-dominant society (Nykvist and Whitmarsh, 2008, page 1373) including traffic congestion, air quality and physical inactivity (Dill and Rose, 2012). The transport sector accounts for the fastest growing contributor of global CO^2 emissions (WHO, 2019) and in London, 8.1 million tonnes of CO^2 from transport are produced each year (GLA, 2018). Despite the societal challenges stemming from rising car use, globally the car industry represents the largest manufacturing sector (Nieuwenhuis et al., 2004), and in the UK it is recognised that the road network plays a critical role in national and local economic prosperity (HE, 2017). A key societal and policy challenge is therefore to retain the economic benefits associated with a carbon-intensive transport regime, whilst transitioning to a more sustainable system of mobility (Kohler et al., 2009).

There is no accepted definition for sustainable mobility (Litman and Burwell, 2006), and terms relating to sustainability generally tend to be arbitrary and therefore unclear (Keiner et al., 2004). However, for the purpose of this research, sustainability will be defined as 'the ability to meet the needs of society to move freely, gain access, communicate, trade and establish relationships without sacrificing other essential human or ecological values today or in the future' (World Business Council, 2004, page 5). Policy measures implemented to increase levels of sustainable transport have often focused on technical solutions, which can be ineffective as they are outstripped by vehicle number increases and travel frequency (Nykvist and Whitmarsh, 2008) (figure 1). It is therefore recognised that behaviour change at an institutional, societal and individual level is needed alongside technological innovation in order to improve the sustainability of transport systems (Whitmarsh, 2012; Robinson, 2004).

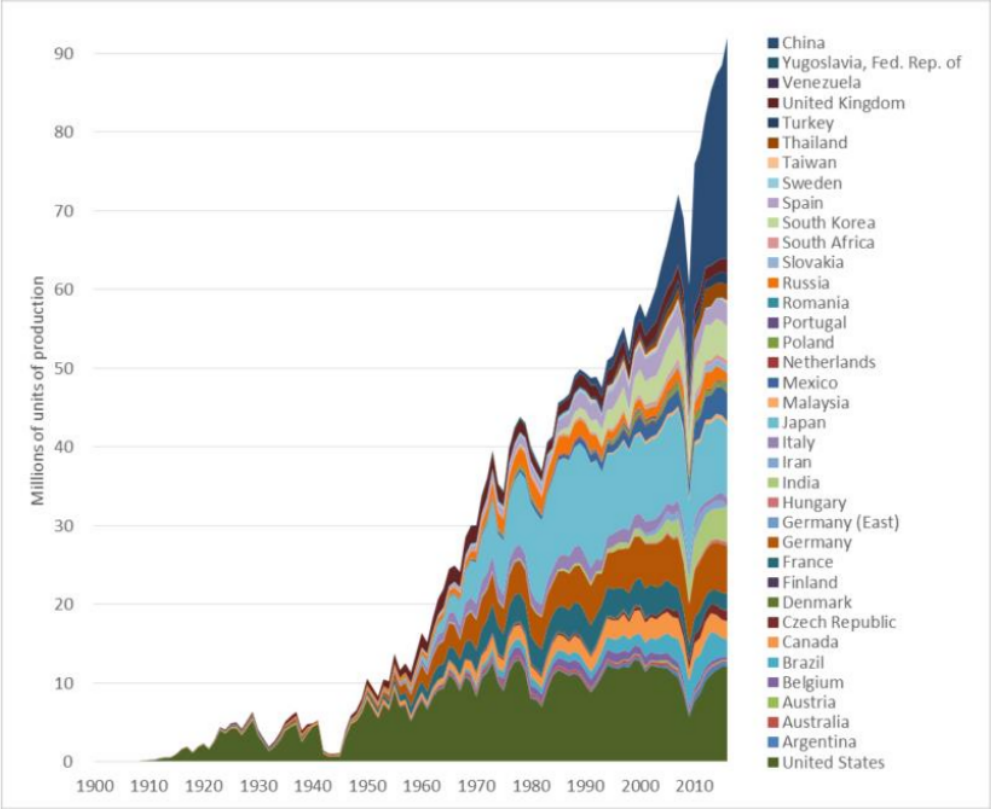


Figure 1: Global car growth (Qualman, 2017).

1.2 What is a 'niche'?

The lens of sustainability research has recently re-focused on the wider, linked processes of socio-technical systems (Smith et al., 2005) within which transition theory sits (Geels, 2005). MLP transition theory encompasses a framework for assessing possible pathways through which a transition to a sustainable mobility society might happen (Kohler et al., 2009). One potential path to a transition is the development of alternative social, behavioural or technological 'niches' (Kemp et al., 2001) which may gain momentum to rival a dominant system. A niche can be defined as a technology outside or peripheral to the dominant system as a locus for radical innovation (Geels, 2005). E-velomobility, referring to mobilities including e-bikes, plays an important role in many visions of sustainable mobility (Behrendt,

2018), and for the purpose of this dissertation e-bikes will be categorised as a niche within the MLP framework.

1.3 E-bikes

E-bikes are thought to be environmentally superior to other motorised modes of transport (Dave, 2010), and can reduce carbon emissions in cities where their use is widespread (Behrendt et al., 2018). They have the potential to expand the role of bikes (MacArthur et al., 2014) as they can overcome commonly-cited barriers to traditional bike riding such as topography, time, and distance (Heinen et al., 2010; Langford, 2013). An e-bike can be defined as resembling a standard pedal bike but with an added rechargeable battery and electric motor to assist with propulsion (MacArthur et al., 2014) (figure 2). Global e-bike sales are growing rapidly with over 40 million e-bikes sold in 2015 (Fishman and Cherry, 2015). E-bikes have the potential to combat many negative aspects of a car-based transport system such as road safety, air quality and helping people to meet recommended physical activity levels (Dill and Rose, 2012), and e-bikes have also been shown to help reduce car use (MacArthur et al., 2014). Despite this, the use of e-bikes as a mainstream transport mode is mainly confined to China and the Netherlands (Jones et al., 2016; Cherry et al., 2009) with uptake low in the UK (Cairns et al., 2017).

Figure 2: E-bikes common in Europe and the US (Fishman and Cherry, 2015).

In global cities such as London, city-wide cycling levels have doubled since 2000 (Pucher et al., 2008). However, traditional pro-car policies have meant that areas of London are still car-dominated, and 8 million trips are made daily in the capital by motorised modes that could otherwise be cycled (TfL, 2017). With the population of London due to increase to 10.8 million by 2041 (Mayor of London, 2018), a shift away from car use and towards more sustainable transport modes is essential if London and the UK are to meet their sustainability targets (DfT, 2017). Studies of e-bikes in the UK have been minimal (e.g. Cairns et al., 2017),

and although the DfT is beginning to recognise the potential of e-bikes as part of its sustainable transport strategy (Jones et al., 2016), the Mayor's Transport Strategy for London mentions e-bikes only once (Mayor of London, 2018).

In order for the e-bike niche to gain momentum and emerge as an integral part of a sustainable transport system in London, behaviour change will be required at multiple levels of society (Geels, 2011). However, more research is needed on attitudes and perceptions towards e-bikes to ascertain why and how this might happen. Therefore, this research will explore the attitudes and perceptions of transport users in London to understand the barriers to e-bike adoption and to identify if e-bikes have the potential to transition from a technological niche to a mainstream mode of transport. Furthermore, the experience of an 'e-ride-along' for non-e-bike users will take place to understand whether attitudes towards e-bikes can change, and how the e-bike market can be targeted at those 'locked in' to using unsustainable transport modes.

1.4 Research question and objectives

The aim of this dissertation is to answer the following research question: to what extent do e-bikes have the potential to transition from a transport niche to a mainstream transport mode in London? This research will be framed by the MLP whilst addressing some of its limitations. The research question will be answered through the following objectives:

O1: to identify which behavioural factors influence Londoners' travel mode choices

O2: to understand which barriers to e-bike use are most prevalent in London

O3: to explore whether the common perceptions of e-bikes from non-e-bike users vary between demographic groups

O4: to assess to what degree e-ride-along participant's attitudes towards e-bikes change after riding one

1.5 Dissertation Structure

The following chapter, chapter 2, will examine the current literature on e-bikes and behaviour change theory followed by a critical analysis of the MLP framework. Chapter 3 will introduce the case study of London followed by an explanation of research methods. Chapter 4

encompasses the results and discussion of the survey and e-ride-along findings. Chapter 5 then presents a conclusion to the study and offers suggestions for further research.

Chapter 2: Literature Review

Over the past three decades, increased levels of research interest in e-bikes has paralleled global growth in sales (Jones et al., 2016), defining e-bikes as an emerging topic of urban transport and sustainable mobility (Munkacsy and Monzon, 2017). Despite this, there are several gaps in the e-bike literature (Fishman and Cherry, 2015) including studies focused on North America and Europe (Dill and Rose, 2012). This literature review will explore behaviour change theory, followed by themes of e-bike research. It will then review the literature on the MLP, analysing its strengths and limitations, before applying it to the e-bike niche. The findings from this literature review will then be applied to the case study methodology.

2.1 Behaviour change theory

Transport policy measures aimed at reducing car use have traditionally been categorised into either 'hard' measures such as provision of infrastructure for public transport, or 'soft' measures, such as behavioural strategies to persuade people to switch to sustainable transport modes (e.g. Taylor, 2007). These soft transport policy measures are grounded in psychological research theories such as the theory of planned behaviour (TPB)(Bamberg et al., 2011).

2.1.1 TPB

TPB is the most common and influential theory used to explore attitude and behaviour in the travel field (Anable et al., 2006), hence its consideration in this study. It states that behavioural intention is a function of the individual's attitude towards the behaviour, subjective norms and perceived behavioural control (PBC) (Ajzen, 1991) (figure 3). TPB theories have been widely used to explore propensity to cycle (e.g. Dill et al., 2014; Bamberg and Schmidt, 2003). TPB is generally seen as a useful model for predicting behaviours and behavioural intentions (Armitage and Conner, 2001) and has led to many successes (Avineri, 2012).

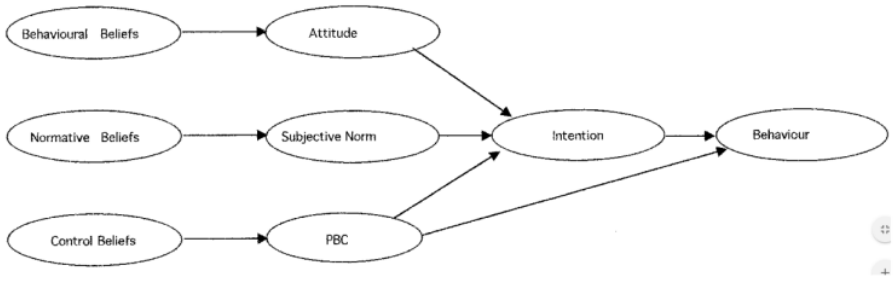


Figure 3: The Theory of Planned Behaviour (Armitage and Conner, 2001).

However, it is recognised that TPB can overlook the systematic biases in decision making (Sliwowski and Olejniczak, 2015) as it assumes that people make rational decisions based on all the information available to them. TPB is also thought to have limited predictive validity (Sniehotta et al., 2014), as even if individuals form an intention, they can still fail to act. There is a growing body of research that suggests habit strength amongst other things is much better at predicting behaviour than TPB (Gardner et al., 2011), as subtle changes to travel choices outside an individuals' awareness can result in behaviour change without affecting intention or PBC (Sniehotta et al., 2014). The role of habit will therefore also be considered.

2.1.2 Habit

The role of habit, sometimes described as behavioural lock-in (Jackson, 2004), is increasingly recognised as influencing travel behaviour, as a strong habit of using a particular transport mode is associated with a lower probability of considering alternative modes for a journey (Moser et al., 2018). Some studies argue that habits influence travel behaviour over and above attitudes or intentions (de Bruijn, 2010) however others argue that personal and social norms remain important (Klockner and Matthies, 2004). Habits can be altered by key events such as a change of situational context (Muggenburg et al., 2015). This idea has been incorporated into a range of studies assessing whether e-bikes have the potential to replace car trips. For example, offering e-bike trials to car users has been shown to disrupt daily routines and habits and trigger behavioural changes in mobility patterns (e.g. Larcom et al., 2015; Cairns et al. 2017).

2.2 E-bikes

2.2.1 The impact of e-bikes on trips

A research theme emerging from the literature is the impact of e-bikes on travel behaviour (Fishman and Cherry, 2015). E-bikes are thought to increase participation in cycling, increase the number of cycling trips undertaken and increase the distance cycled (Fyhri and Fearnley, 2015; Popovich et al., 2014; Ling et al., 2017). Langford (2013) found that e-bike journeys are used for a greater variety of trip purposes when compared to regular cycling, comprising both recreational and commuter trips. Wolf and Seebauer (2014) found that older users of e-bikes were more likely to use their e-bike for leisure trips, however Cairns et al. (2017) found that the dominant trip purpose was commuting during an e-bike trial in Brighton where the sample age was younger. Findings from Ling et al. (2017) were similar, where it was found that younger generations primarily use e-bikes for utilitarian travel.

The magnitude of effect of e-bikes in substituting car journeys and affecting household car ownership is unclear within the literature (Fishman and Cherry, 2015), but it is generally a frequently cited potential benefit of e-bikes (MacArthur et al., 2014). Replacing motor vehicle trips with e-bike trips can lead to benefits such as reduction in congestion and emissions, and increased physical activity (Gojanovic et al., 2011). Research by MacArthur et al. (2014) found that 65% of e-bike owners bought an e-bike with the intention to replace car trips, and studies in China found that up to 25% of e-bike trips replaced car trips (Cherry et al., 2014). Cairns et al. (2017) also showed a 20% decrease in car miles driven during an e-bike trial for participants in a UK study.

However, there is concern amongst policy makers that e-bike trips are more likely to replace walking, cycling and public transport trips (Behrendt, 2013). Drage and Pressl (2012) showed that e-bikes are comparable or better than public transport trips in terms of speed, and in Langford's (2013) study only 11% of e-bike trips replaced car trips, with the rest replacing more sustainable modes. A Netherlands-based study found that 33% of e-bike commuters had switched from conventional bikes compared to 16% from the car (Hendirksen et al., 2008). However, little data exists on the true extent of car trip replacement (Fishman and Cherry, 2015) as the studies outlined above are small scale, geographically restricted and very

context-specific. In addition, much of the research relies on self-reported behaviour and is subject to response bias (Jones et al., 2016).

2.2.2 Demographics of e-bike users

There is much discussion within the literature surrounding the typical demographic characteristics of e-bike users. Demographics have implications for barriers to e-bike use, as barriers to e-bikes and regular bikes will be perceived differently depending on factors such as age and gender (Heinen et al., 2010). Demographics can also affect the rate of e-bike uptake. For example. e-bikes are traditionally thought to be popular among older and disabled people as an alternative to leisure cycling (Plazier et al., 2018; Wolf and Seebauer, 2014; Johnson and Rose, 2015). However, as e-bikes have gained popularity, young people are thought to increasingly represent a market segment for the early adopters of e-bikes (Roetynck, 2010). The extent to which e-bike popularity will increase may depend on the rate of adoption by a broad range of demographic groups (Plazier et al., 2018), so any e-bike study should represent multiple user groups within its scope.

Gender issues within cycling are well documented (Fyrhi and Fearnley, 2015). In societies with low cycling shares and poor cycle infrastructure, cyclists are more likely to be men than women (Garrad et al., 2008). Although e-bikes have the potential to address this gender imbalance as barriers to cycling such as topography and distance are reduced (Chiu and Tzeng, 1999), some e-bike studies still suggest that more men than women are using e-bikes. For example, surveys in Switzerland (Hasher, 2012) and Germany (Hacke, 2013) on e-bike habits got far more responses from men than women. The literature discusses that women can perceive barriers to cycling differently from men, especially when related to safety (Fyhri and Fearnley, 2015). It could therefore be logical to expect that barriers to e-bikes may also be perceived differently depending on gender. A greater understanding of how e-bike barriers are perceived by women is important due to the opportunity presented by e-bikes to increase cycling levels amongst women (Dill and Rose, 2012).

2.2.3 Barriers

A limited number of American and Australian studies have investigated the barriers to e-bike use (e.g. Dill and Rose, 2012), and it is essential that these barriers are addressed if cities want to increase cycle modal share (MacArthur et al., 2014). Although e-bikes are thought to

overcome various barriers to conventional cycling (Fyhri and Fearnley, 2015), they come with their own set of challenges. A summary of barriers identified within the literature is available in table 1 below.

Source	Barriers to e-bike use
Dill and Rose, 2012	Relative cost, weight of the bike, fear of theft, road danger, lack of supportive infrastructure and 'range anxiety'
Popovich et al., 2014	Security concerns including risk of theft, road safety including interactions with other bikes, range anxiety, and perceptions by non-users
Jones et al., 2016	Cost, weight, range anxiety, social stigma, safety, lack of cycling infrastructure and parking
Arsenio et al., 2018	Absence of segregated cycle lanes
Ling et al., 2017	Cost (particularly amongst younger respondents)
Stromberg et al., 2016	Safety of e-bikes when used in mixed traffic, poor quality of roads, safe parking, social stigma and unwieldy
Astegiano et al., 2015	Lack of e-bike charging facilities at work and in local neighbourhoods, poor pavement conditions and road markings

Table 1: Barriers to e-bike use

2.2.3.3 Safety

The growth of e-bikes in areas such as China has raised various safety concerns (e.g. Feng et al., 2010) which has led some North American cities to consider limiting where e-bikes can operate (Goodman, 2010). Concerns relating to e-bike use within the literature can refer to interactions with other road users including regular bikes (Popovich et al., 2014), road danger (Dill and Rose, 2010), poor pavement conditions (Astegiano et al., 2015) and lack of cycle infrastructure (Jones et al., 2016). However, e-bikes also have the potential to improve

perceptions of safety, especially when compared to regular bikes. For example, MacArthur et al. (2014) found that 42% of people who took part in an e-bike trial felt that using their e-bike had helped them to avoid a crash, and studies in China found that interaction with intersections on an e-bike felt safer than on a regular bike (e.g. Lin et al., 2008). Judging by the literature, the barrier to e-bike use of 'safety' may therefore be due to external factors such as poor road conditions rather than the e-bike itself presenting a safety risk.

2.2.3.1 Cost

Within the majority of the studies, cost is thought to be a significant barrier (e.g. Popovich et al., 2014; Dill and Rose, 2012; Salmeron-Manzano and Manzano-Agugliaro, 2018) as e-bikes are typically more expensive than regular bikes. However, Popovich et al. (2014) note that the true cost of an e-bike depends on trip purpose, as e-bikes are likely to be cheaper compared to frequently using a car or public transport. For example, Weinert et al. (2007) quantified the cost of running an e-bike at 0.7 cents per km including energy, purchasing and maintenance compared to 0.62 cents per km for a car. A study focusing on barriers to cycling and e-bikes in Norway (Fyhri et al., 2017) investigated how experiencing the benefits on an e-bike can influence perceptions of cost through the willingness to pay (WTP) indicator, and it was found that WTP increased after experiencing the benefits of an e-bike. Price subsidisation, spread of knowledge and the offer of e-bike experiences were recommended to help overcome this barrier (Nocerino et al., 2016). There is a lack of e-bike subsidisation in the UK, with the incentives used to promote electric cars not yet applied to e-bike markets (Behrendt, 2018).

2.2.3.2 Negative Social Stigma

The perception of e-bikes from non-e-bike users could also be seen as a barrier within the literature. It is prominent in the UK, where there is scepticism about e-bikes potentially due to overall low levels of cycling (Cairns et al. 2017). Aldred (2012) theorises that as the UK is typically dominated by cars, stigmatised 'cyclist' identities are generated which may also encompass e-cyclists. Popovich et al. (2014) separates the negative perceptions of non-e-bike users into two themes: that e-bikes are meant for recreational use, and that they are classed as 'cheating' by other cyclists. More studies of non-e-bike users are needed to determine how deeply these cultural ideas are rooted, and whether they are a barrier to e-bike adoption.

2.3 Socio-technical transitions

Socio-technical transition theory is multi-disciplinary and encompasses entire social regimes, particularly appropriate for complex problems of sustainability (Whitmarsh, 2012). A socio-technical regime such as a transport system is made up of technology, regulation, user practices and cultural meaning which work together to achieve functionality (Geels, 2005). These elements are maintained and stabilised by actors such as firms, policy makers and consumers (Geels, 2011), and their normative and regulative restrictions (Geels, 2005). These interdependent actors and processes can lead to path dependency and system lock-in which stifles innovation (Smith et al., 2005) and prevents straightforward transitions between systems. Transforming our unsustainable transport systems into sustainable configurations is a significant challenge for policy makers (Berkout, 2002), due to the process being complex, long-term, and involving multiple actors and deep structural changes (Geels, 2011).

Transitions towards sustainability are arguably different compared to historical transitions; sustainability transitions are goal-oriented rather than emergent (Smith et al., 2005), they are associated with less consumption rather than growth (Urry, 2011), and a heightened importance is attributed to the role of civil society where negative externalities towards sustainability need to be overcome (Elzen et al., 2011). Within socio-technical transition literature, multiple studies have used the MLP framework to analyse transport and mobility systems (e.g. Shove, 2003; Whitmarsh et al., 2009) which will be analysed in the following section.

2.3.1 The MLP

Originally developed by Rip and Kemp (1998), the MLP has since been theoretically elaborated (e.g. Grin et al., 2010). The MLP can be a useful analytical framework for understanding transitions (Whitmarsh, 2012) as it is multi-dimensional and has a broader scope compared to other innovation and transition frameworks (Geels, 2011). The MLP describes the structure and dynamics of socio-technical systems as three levels through which the path of transitions can be analysed (Whitmarsh, 2012) (figure 4): the landscape relates to macro-level trends, with contextual drivers and barriers to change including political culture and the macro economy. The regime relates to dominant practices, rules and beliefs at meso level which aim to optimise rather than transform systems. The niche level relates to

individual actors and technologies where deviations from the prevailing system can occur (Rotmans et al., 2001). It is thought that transitions require innovation at niche level, realised by a variety of participants, to change the structure of the system (van der Brugge et al., 2006).

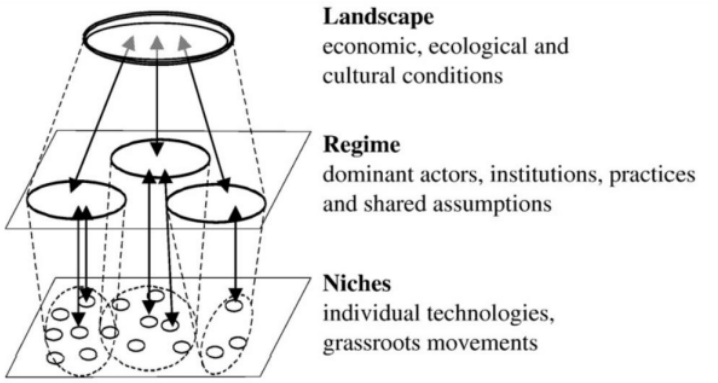


Figure 4: The MLP (Nykvist and Whitmarsh, 2008).

The importance of the niche level means that niche development is central to understanding sustainable transitions. Niches can impact on the regime through accumulation where niche applications gradually grow before emerging in mass markets (Nykvist and Whitmarsh, 2008). Alternatively, they can emerge through the processes of technological add on or hybridisation, where new technology physically links with established technology, enabling a smooth transition between practices (Nykvist and Whitmarsh, 2008). The role of pathway technology can be central to a transition in order to bridge the gap between the current regime and the new sustainable one. Examples of pathway technology include emerging information for new technologies such as e-bikes or technology associated with behavioural change (Elzen et al., 2004). It is recognised that both a large-scale shift in preferences and choices of consumers and lasting policy action are prerequisites for niche technologies to accumulate or hybridise (Kohler et al., 2009).

The MLP has been applied extensively to case studies of historical transitions, such as Geels' (2005) well-cited example of the transition from sailing boats to steam ships. The MLP has also been applied to sustainable transition case studies such as Whitmarsh (2012) whose research found that alternative technology niches that were closely aligned to the regime, such as low-emission vehicles, were likely to gain momentum. MLP studies assessing the

dynamics of niche accumulation such as Kohler et al. (2009) found that innovation niches were only likely to accumulate in the longer term once infrastructural regime barriers had been broken down. However, an MLP study on e-bikes (Lin, 2016) found that the fast emergence of e-bikes in China was spontaneous and without direct policy support from the government, which could highlight the importance of user influence within a transport regime when transitioning to widespread e-bike use. For the purposes of this study, the MLP has been conceptually applied to the London transport case study (figure 5).

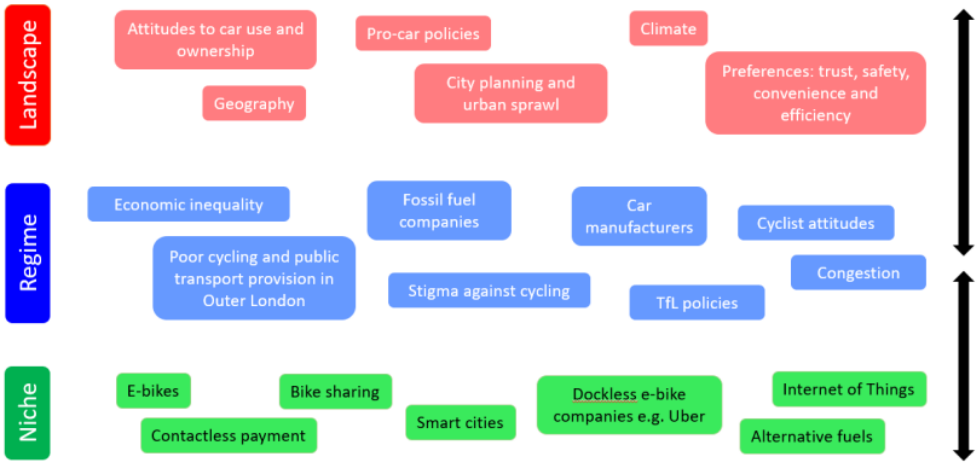


Figure 5: The MLP applied to the London transport regime (author's own, adapted from Carter et al., 2017).

2.3.2 Limitations

Although the MLP has proven a fruitful approach to socio-technical transitions, it has also received some criticism (Geels, 2011). One such criticism is the MLP's lack of agency. Smith et al. (2005) criticise the social aspects of the MLP, as the MLP tends to focus on technological process rather than the role of actors and the importance of social context. Geels (2011) responds to this criticism and states that although actors are not explicitly identified, the MLP accommodates agency in the form of bounded rationality, and because transitions are always enacted by social groups. However, it is still thought that certain types of agency remain underdeveloped, and therefore there is scope to enhance the MLP by integrating insights from the sizeable literature on habits, behaviours and social norms (e.g. Shove, 2010; Elzen et al., 2011) which may influence a niche's propensity to emerge in the mass market.

Incorporating these aspects within the MLP may be especially important when studying sustainability transitions that rely on changing user travel behaviour, as travel choices are influenced by a wider range non-rational factors (e.g. Mann and Abraham, 2006).

2.4 Implications for this study

Following the literature review above, several conclusions can be drawn and research gaps identified which will be addressed in this study:

- More research is required to explore the perceptions of e-bikes for non-e-bike users in order to identify the main barriers to wider uptake.
- The perceived barriers to e-bike use will partly depend on user demographics, therefore a range of user groups should be incorporated into the study.
- A key MLP limitation is its lack of consideration of non-rational behaviour at an individual level. The TPB alongside the role of habit are therefore suitable for incorporation into the MLP.
- Many e-bike studies emphasise the importance of breaking habits in order to encourage more sustainable travel choices. Experiencing the benefits of an e-bike can be an effective way changing travel contexts and potentially disrupting travel habits.

This study will take these conclusions into account to assess whether e-bikes have the potential to transition from a transport niche to a mainstream transport mode in London.

Chapter 3: Methodology

Taking into account the aims and literature review of this dissertation, a case study approach consisting of both qualitative and quantitative data collection methods will be used to answer the research question (figure 6). Case study methodology is widely used in many disciplines (Noor, 2008). It is justified by both qualitative and quantitative researchers, and is preferred when investigating a contemporary phenomenon within its real-life context (Yin, 2003) as is the case for an e-bike transition (Lin, 2016). Case studies are also regularly used in MLP studies as the main analytical tool in the exploration of dynamics within the framework (Geels, 2005). By implementing a mixed methods approach, the study will aim to elaborate the findings of one method with another method (Cresswell, 2003) which is thought to generate useful and coherent findings in complex studies (Jogulu and Pansiri, 2011).

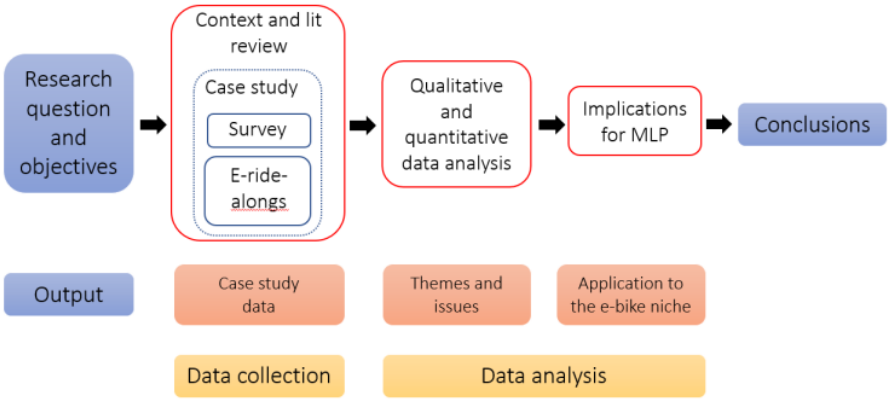


Figure 6: Research methodology for data collection and analysis (author's own).

3.1 Case Study

London has been chosen as the case study area (figure 7) for a number of reasons. Firstly, a rapidly increasing population means that the problems associated with an unsustainable transport system are accentuated, therefore sustainable solutions are increasingly urgently sought. Secondly, although sustainable transport modes such as walking and cycling levels have increased in recent years (Mayor of London, 2018), millions of journeys in London are

still made by unsustainable modes, which would need to be reduced if a sustainable transition is to take place. Thirdly, although information on e-bike use in London is scarce, levels are thought to be low compared to other European cities. The reasons for this should be established in order for policy to be adapted to encourage their uptake. Finally, dockless e-bike schemes have recently been introduced to the capital such as Lime-E and Jump by Uber (The Guardian, 2019) which may present a unique opportunity for the e-bike niche to accumulate momentum and challenge the prevailing regime.

Figure 7: Case study area (hiddenlondon.com).

3.2 Mixed survey method

A self-administered internet-based survey consisting of closed, linear and open-descriptive questions was chosen to assess attitudes to travel in London and perceptions of e-bikes (see Appendix A). A range of question-type ensured that both quantitative and qualitative methods were applied in order to explore objectives and answer the research question. Survey results were inputted into Excel which enabled quantitative and qualitative analysis to take place.

The survey was directed at the general public, a key actor within a transport system (Geels, 2011). It was distributed across various social media platforms which may have led to sampling bias; however, this was mitigated through distribution of the survey to a range of community groups in London which encompassed people of a range of demographics. The survey took 5 minutes to complete, and 141 responses were gathered over a two-week period in July. Survey respondents were given the opportunity to leave their email address at the end of the survey if they were interested in trying out an e-bike as part of the research, which created a pool of contacts that could be used for the e-ride-alongs.

Advantages of self-administered surveys include that they are time and cost efficient (Bourque and Fielder, 2003), they provide private space for survey respondents who are less likely to be influenced by the characteristics of the interviewers (Bryman and Bell, 2007), and utilising the internet presents an opportunity to reach a wide audience. The method does however come with various limitations; it can be difficult to guarantee a high response rate (Kiesler and Sproull, 1986), and lack of interaction with the survey administrator may lead to response bias (Jones et al., 2016). However, the effectiveness of surveys at capturing attitudes of the general population (Javid et al., 2018) towards a concept such as e-bikes make it a valuable tool.

3.3 E-ride-alongs

Semi-structured interviews were chosen as the qualitative study method as they allow a deep exploration of attitudes and perceptions (Beirao and Cabral, 2007), from which the e-bike research field could benefit. In this study, semi-structured interviews were carried out in the format of a ride-along interview, which is a valuable methodology enabling the researcher to discuss experiences, feelings or ideas with the interviewee whilst cycling (Ghekiere et al., 2014). Ride-alongs are a relatively new concept, adapted from 'walk-alongs' (Carpiano, 2009) and can produce rich narratives as they are highly context specific and very relevant to active travel studies (Evans and Jones, 2011). Additional strengths of ride-alongs are summarised by Wegerif (2018), and this research will develop this method of qualitative research further within transport studies by introducing and adapting e-bikes into the ride-along methodology, coined 'e-ride-alongs'.

10 e-ride-alongs were completed in July 2019 with participants who use a range of travel modes in London but had not regularly used e-bikes before. The e-ride-along presents a way

for attitudes to be assessed whilst providing a situational context change which can help to break unsustainable travel habits (Cairns et al., 2017). It also allows observation of whether attitudes towards e-bikes change after experiencing an e-bike trip, as the literature suggests that this may be an effective way for barriers to e-bikes to be reduced (Fyhri et al., 2017). Uber Jump bikes were used to carry out the research due to their abundance in certain parts of London. All interviews were conducted using broadly the same questions (see Appendix B). They were then recorded, transcribed and textually analysed to ensure comparability with survey responses.

3.4 Ethics/risk assessment

Ethical consent was gained for the e-ride-alongs prior to beginning the interviews, and a cover page on the survey clearly outlined the research aims of the study and that responses were anonymous. Ethical considerations were given during the interviews such as gaining permission to record and stating that answers would be anonymous. No ethical concerns were raised, and the risk assessment can be found in Appendix C.

Chapter 4: Results and Discussion

4.1 Demographics

As the perceived barriers to e-bike use may partly depend on user demographics, it is important that the age and gender of e-ride-along and survey samples are taken into account. Figures 8 and 9 illustrate the constraints of the sampling strategy and survey distribution method used, with the 25-34 age group category over-represented in both the survey and e-ride-along results. Despite this limitation, results may still go some way to exploring the attitudes of a range of demographics. Slightly more men than women responded to the survey which is consistent with other e-bike studies (e.g. Hacke, 2013). Genders were balanced for the e-ride-alongs.

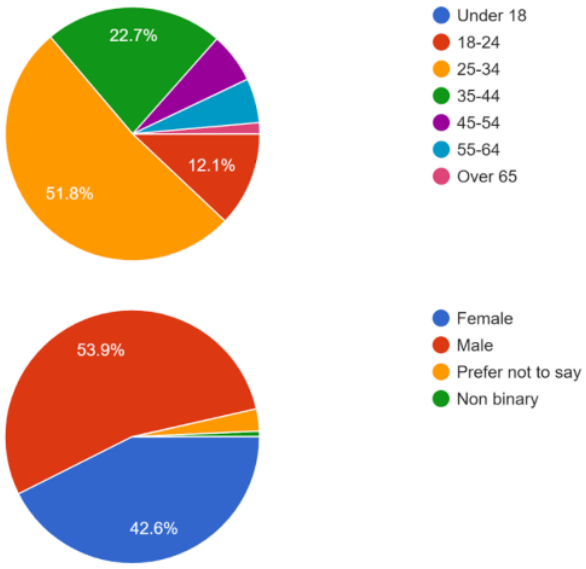


Figure 8: Age and gender demographics of survey respondents

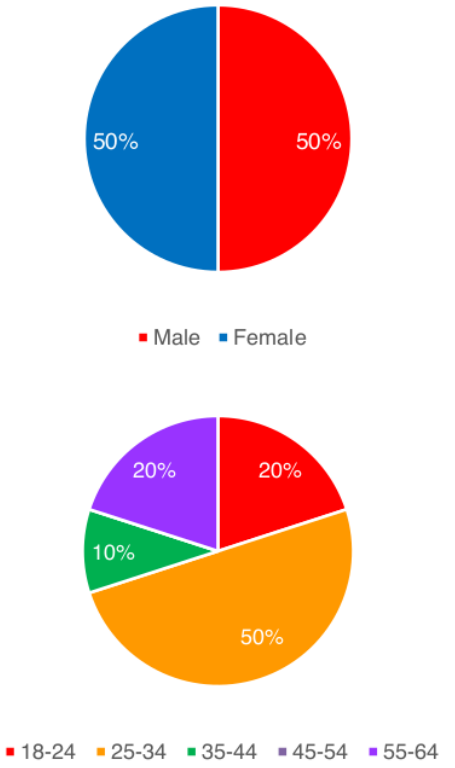


Figure 9: Age and gender demographics of e-ride-along participants

4.2 Factors that influence travel mode choice

Understanding travel behaviour and the reasons for choosing one mode of transport over another is a complex challenge (Beirao and Cabral, 2007). In order to identify which behavioural factors influence Londoners' travel mode choices, likert-scale statements were used to measure the relative importance respondents attributed to a variety of rational, TPB and habit-based reasons for travel mode choice. Exploring this is important as results may have implications for how levels of e-bike use are most likely to increase, and how the issue of agency within the MLP should be approached.

4.2.1 Rational factors

Similar to studies by Anable and Gatersleben (2005) and Steg et al. (2001), results showed that utilitarian or rational factors such as cost and time play an important part in influencing travel mode choice (figure 10). Results also show that survey respondents attached greater importance to cost and especially time for commuting trips compared to leisure trips, as can be seen from the trend lines below. Similar patterns were reflected during the e-ride-alongs as when asked about influences on their commuting patterns, participants often quoted time and cost as important factors. This implies that in order to be widely accepted as a commuting mode, e-bikes would need to be priced competitively in comparison to other modes, alongside being time-efficient.

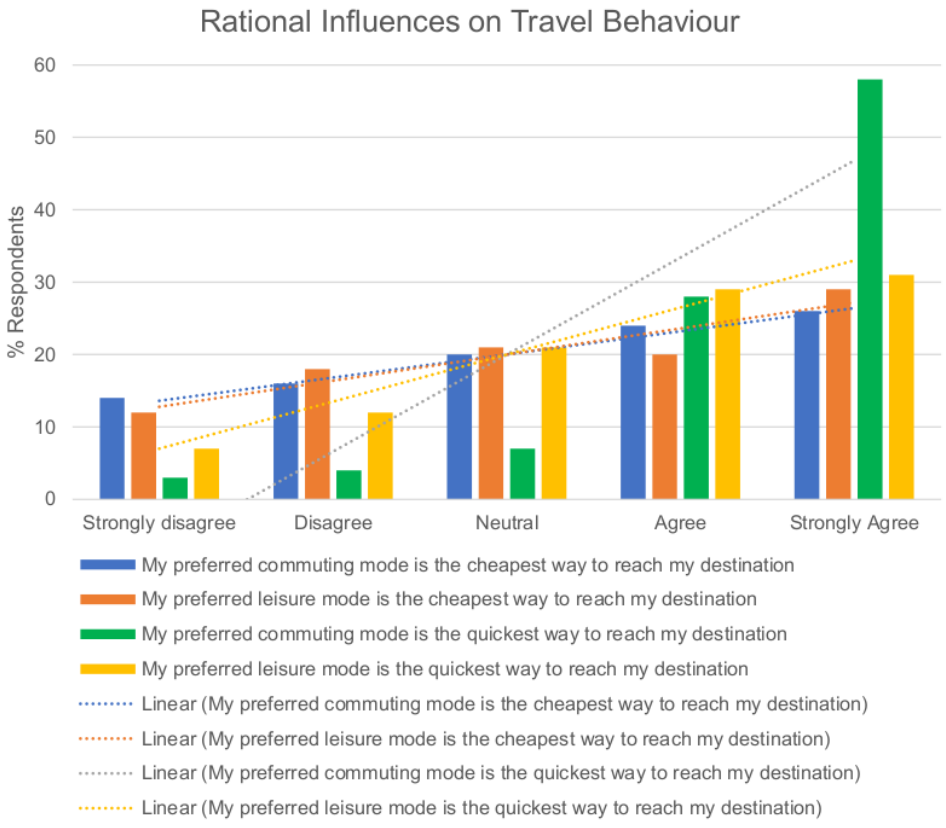


Figure 10: Rational influences on travel behaviour

Some literature states that for leisure journeys, travel mode choice may be influenced equally by both rational and non-rational factors (e.g. Lois and López-Sáez, 2009). This idea was reinforced during the e-ride-alongs where interviewees were asked what was important to them when travelling around London for leisure. Answers given included rational reasons relating to time and cost, but also non-rational reasons relating to being active, being outside and feelings of safety and relaxation. This could mean that for leisure trips, e-bikes may need to fulfil a wider range of criteria aside from time and cost such as comfort and feelings of safety in order to be considered.

Despite non-rational factors being more important for e-ride-along participants' leisure trips, survey responses did not necessarily reflect this. When asked to what extent their mode choice made them feel relaxed and stress-free, results were generally similar for leisure and commuting trips (figure 11). This could show that what people consider important non-rational factors when choosing leisure trip mode do not necessarily translate into the actual trip experience.

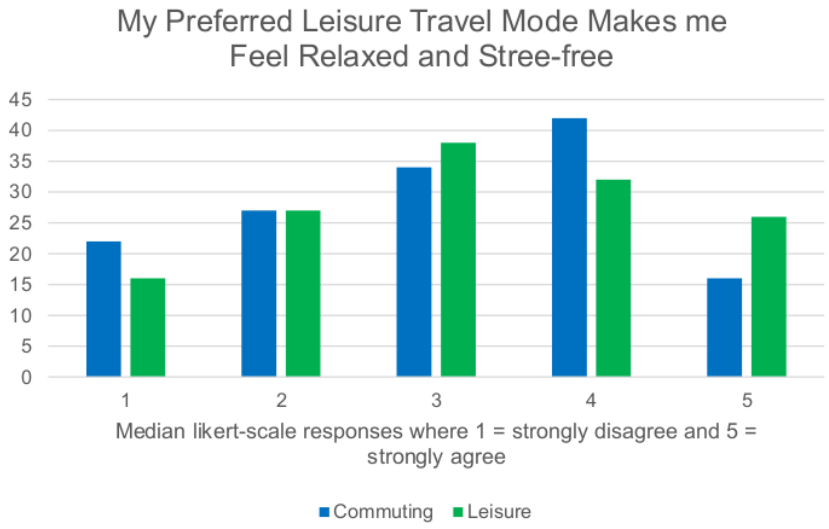


Figure 11: Lack of stress for commuting vs leisure trips

The extent to which people feel relaxed and stress-free during leisure trips could also be broken down modally (figure 12). Results show that active travel modes such as walking and cycling score highest in making the traveller feeling relaxed and stress-free, corroborating

results from Anable and Gatersleben (2005). This implies that riding an e-bike for leisure trips could also score highly in making the rider feel relaxed.

Interestingly, car trips score as 'neutral'. The idea that positive and negative experiences of car leisure trips can balance out to become neutral was discussed during the e-ride-alongs. Interviewees who used cars for leisure trips discussed the negative experiences of driving such as stress due to unexpected traffic or diversions. However, the overall enjoyment of driving seemed to mitigate these negative experiences. For example, interviewee four said that the experience of driving is "great" because you can choose "exactly where and when you want to go". This finding reflects Steg (2005) where cars were found to fulfil important symbolic and affective functions. Therefore in order to reduce car use within the current London transport regime, policy makers should focus on the these non-utilitarian motivations for car use alongside cost and time-based ones (Steg, 2005).

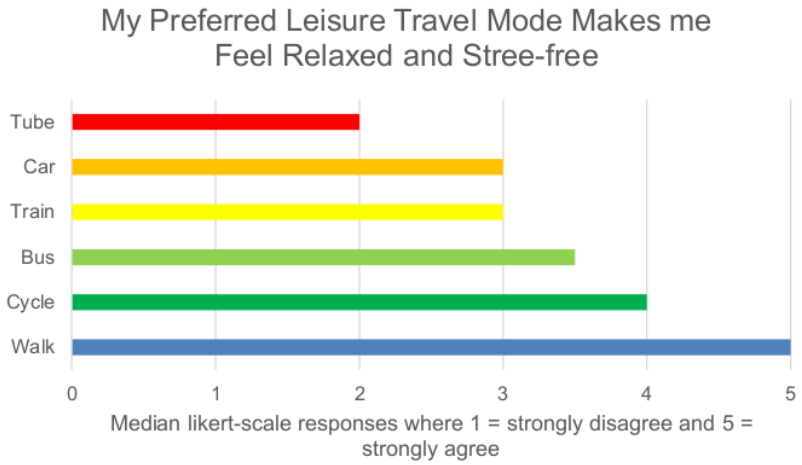


Figure 12: Lack of stress by leisure mode

4.2.2 TPB

Elements of TPB such as subjective norms and PBC (Ajzen, 1991) were incorporated into both the survey and interview questions to assess to what extent these aspects had an influence on travel choices. Results were then broken down by mode (figure 13).

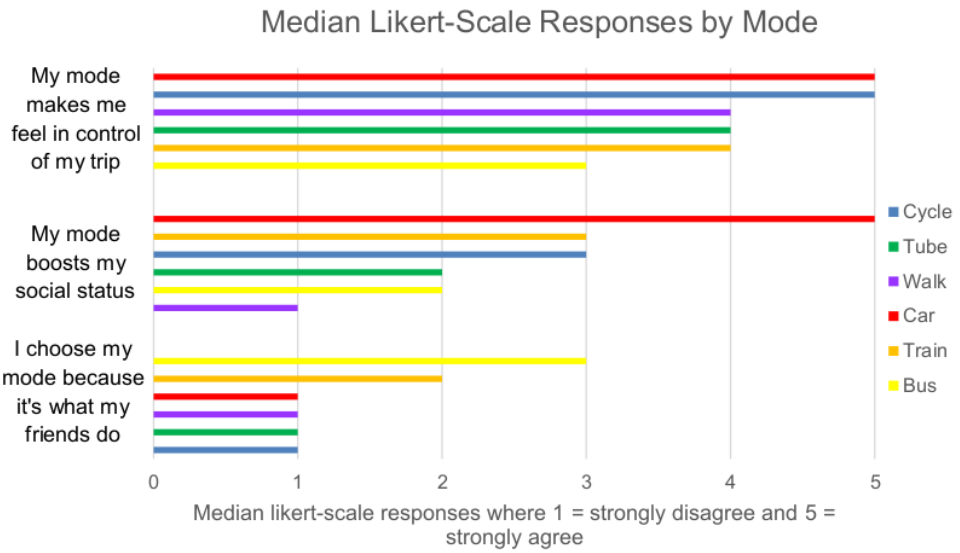


Figure 13: Influence of TPB elements by commute mode

Results showed that generally, respondents do not choose their travel mode because of the influence of their friends. Additionally, median scores for whether respondents felt that their mode choice boosts their social status ranged from one to three, suggesting that these aspects of subjective norms are not an important influence on travel mode choice. The notable outlier here is car commuting trips, however this counted for less than 1% of survey results.

Overall, results show that a higher PBC may be an important determinant on commuting behaviour, similar to conclusions made by Lemieux and Godin (2009), because aside from bus commute trips, survey respondents generally felt that their mode choice made them feel in control of their commute. This was especially true for cycling trips, and was also shown in the e-ride-alongs where participants who regularly cycled to work felt strongly that they were in control of the trip. This implies that e-bikes as a commuting mode would also be associated with high levels of PBC.

> "I feel 100% in control, because you don't have to rely on anyone else" – Interviewee three, regular commuter and leisure cyclist.

4.2.3 Habit

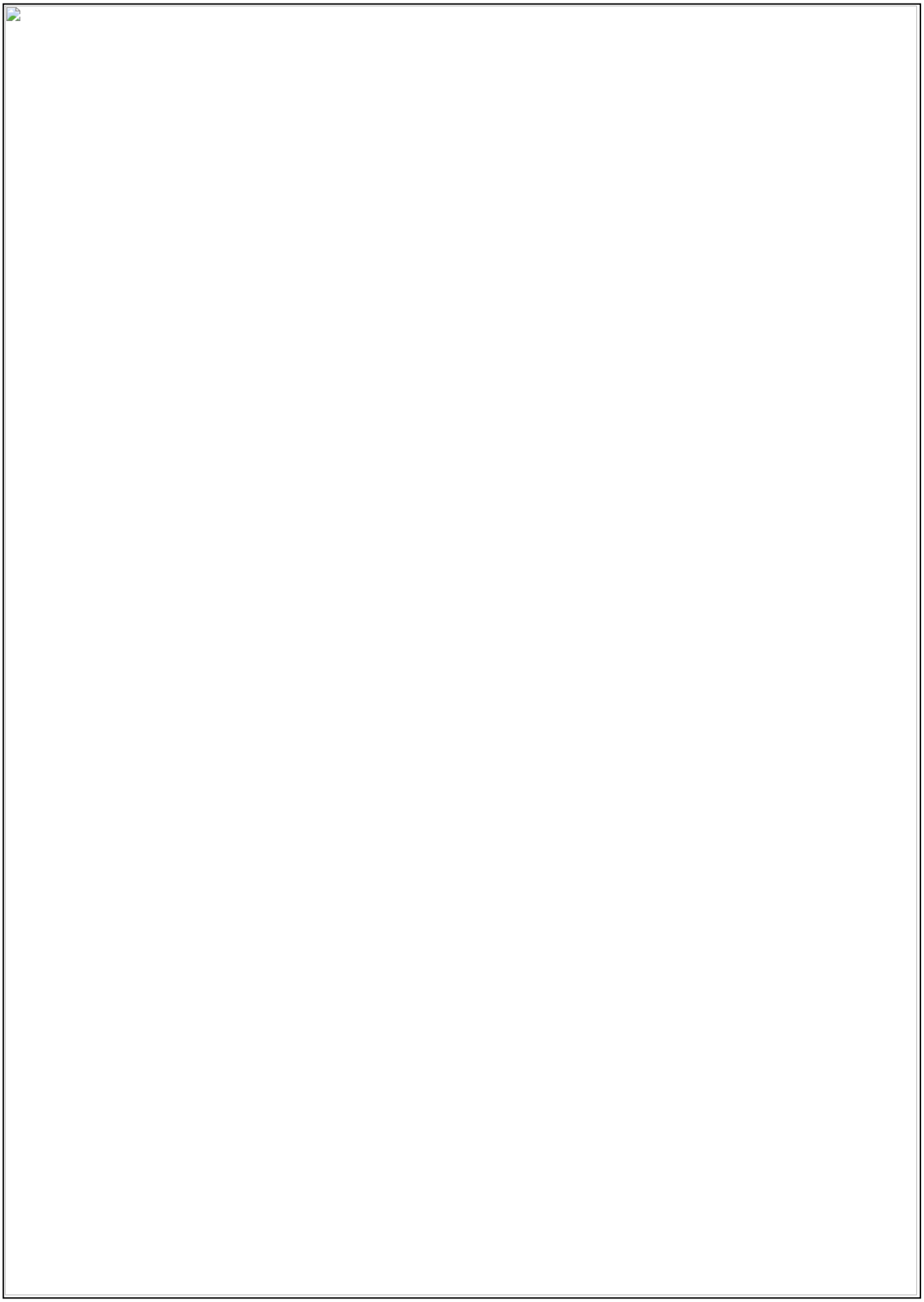
Results show that the role of habit in travel mode choice is important. Although habits are typically difficult to measure (Aarts, 1996), the survey results suggest some interesting patterns. Habitual associations appear to be more strongly represented in commuting trips compared to leisure trips, with 79% of respondents either agreeing or strongly agreeing that they complete their commute 'automatically without too much thought', compared to 54% of leisure trips. E-ride-along participants also exhibited strong habitual associations with commuting trips, but generally tended to consider other factors when completing a leisure trip. Interviewee ten stated that in the last couple of years they cycle-commuted "all the time, because [they] got into the habit of it", whereas they considered different leisure modes depending on "distance, weather and time of day".

These results suggest that due to strong commuting habits, e-bikes may be more likely to be used for leisure trips. However, studies that have involved e-bike trials found that e-bikes were mostly used for commuting trips (Cairns et al., 2017). This may be because trialling an e-bike represents a context change for non-e-bike users which has the potential to alter travel habits (e.g. Salmeron-Manzano and Manzano-Agugliaro, 2018). The e-ride-along consisted of one e-bike journey, so is unlikely to alter travel habits as per Cairns et al. (2017), however it seemed to be an enough to familiarise people with the e-bike concept and facilitate more potential e-bike trips in the future.

> "By being forced (in a way) to try one, it really opens your eyes to the option" – Interviewee eight.

4.3 Barriers

Similar to research by Popovich et al. (2014), Dill and Rose (2012), and Salmeron-Manzano and Manzano-Agugliaro (2018), the results of the survey identified safety and cost as two key barriers to e-bike use for Londoners (figure 14).



However, the powerful propulsion was also seen as a way to improve the perception of safety by some participants. Interviewee five said that "e-bikes may be safer than normal bikes as you can pull away from the traffic nice and quickly".

Results also suggest that barriers to e-bikes are perceived differently between men and women (figure 15). For example, comparatively more women than men think that e-bikes are safer than regular bikes. These findings reflect Lin et al. (2008) where women were found to feel safer than men when traversing junctions on e-bikes. Although there could be many reasons behind women having a more positive perception of e-bike safety than men, the results of this question could be due to men having a more positive perception of regular cycling safety. Rissel et al. (2002) found that increased levels of cycling lead to lower perceptions of fear, and because more men than women cycle in London, they may generally perceive the safety of regular cycling as higher.

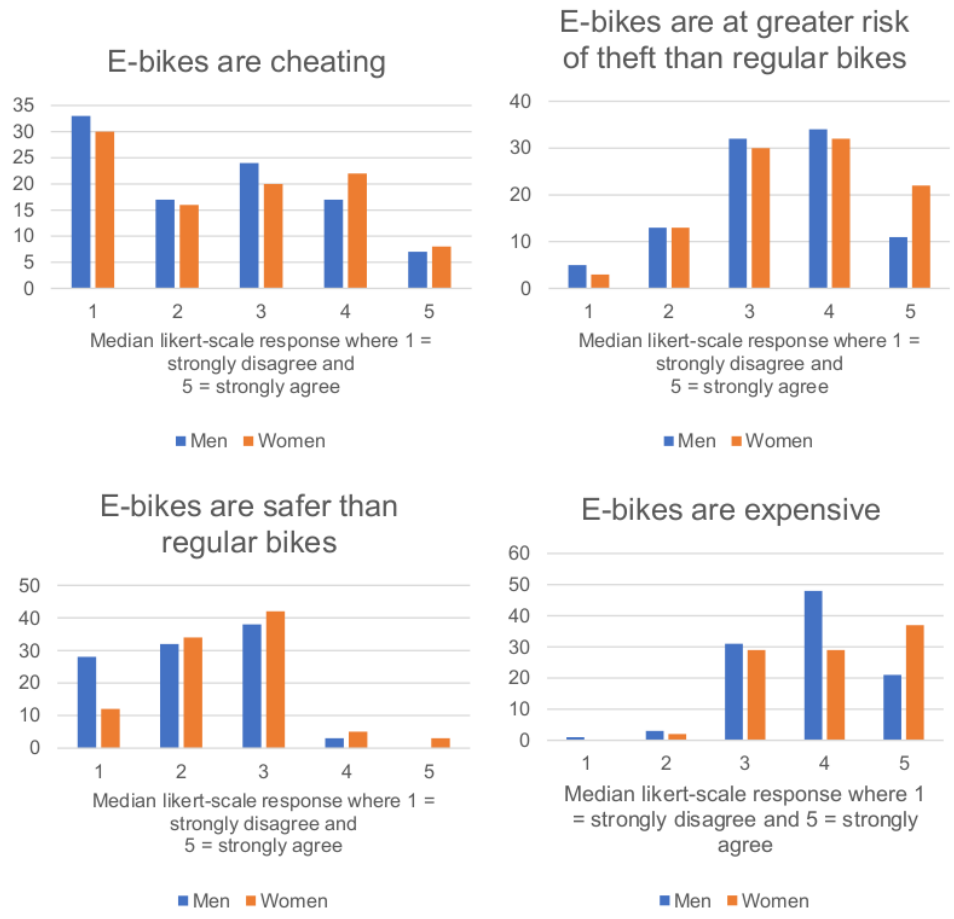


Figure 15: Barriers to e-bike use by gender

The idea that the perception of bike safety is related to overall cycling levels was also highlighted during interviews:

> "The perception of danger is a big barrier [to cycling], but as soon as you get on a bike you realise that the risks aren't really there" - Interviewee nine, male, regular cyclist.
>
> "People think it [cycling] is dangerous but I just don't listen to them" - Interviewee three, female, regular cyclist.
>
> In contrast, "Cycling is a good option but there are too many safety concerns and I know a lot of friends who have been knocked off their bikes" - Interviewee one, female, non-cyclist.
>
> "The road is just too busy with big lorries and too many cars. People do not watch when they cross the road" – Interviewee seven, male, non-cyclist.

An increase in overall cycle levels in London could consequently lead to an improved perception of regular bike and e-bike safety, and consequently reduce this barrier to their use so that the niche has a higher chance of accumulating.

4.3.2 Cost

Figure 12 also shows cost as a key barrier to e-bike use in London, similar to findings by Jones et al (2016). When breaking down how different barriers are perceived by different age groups, results show that attitudes towards price vary with age (figure 16). For the purpose of this analysis, age groups above age 55 were not included due to low respondent numbers in these categories.

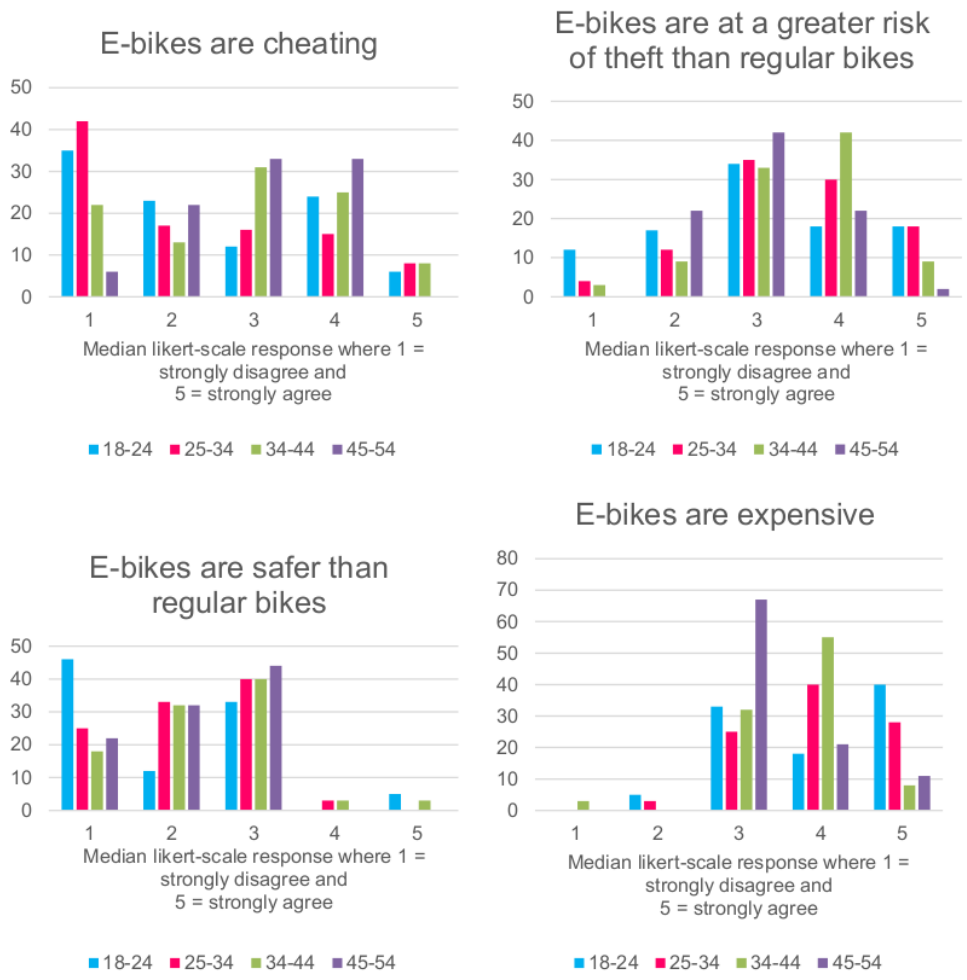


Figure 16: Barriers to e-bike use by age

Figure 16 shows that a high proportion of 18-24s strongly agree that e-bikes are expensive, similar to findings of Ling et al. (2017) where the cost of e-bikes was a particular barrier for young people. However, similarly a high proportion of 34-44s agree that e-bikes are expensive, which suggests that cost may be a universal barrier for many age groups. That cost is a key barrier for younger people was also not clear from the e-ride-along analysis, where participants in the 18-24 category were uncertain about the cost of purchasing an e-bike. Interviewee one agreed that e-bikes were cheaper than running a car and identified the replacement of battery parts as a potential expense, but didn't mention the upfront cost of buying an e-bike as being a problem. Interviewee two thought that the dockless e-bike trip

was cheaper than expected, but thought that "being aware that you are spending money per minute" could put people off using them. The barrier of 'cost' within the literature often refers to the upfront price of purchasing an e-bike (e.g. Popovich et al., 2014), however it may be more appropriate to consider the barrier of e-bike cost as multi-faceted, especially given the increase in dockless e-bike usage in cities.

4.3.3 Negative social stigma

The negative social stigma of using an e-bike is also identified in the literature as a barrier to widespread adoption (Popovich et al., 2014). However, when survey respondents were asked whether they agreed that e-bikes had a negative social stigma attached to them, results showed that only 17% agreed or strongly agreed, suggesting that negative social stigma may not play a part in the lack of e-bike uptake. In contrast, survey respondents were also asked to elaborate on their initial impressions of e-bikes as a transport mode, where answers suggested several negative social perceptions (figure 17). This difference in results suggests that negative social stigmas of e-bikes may exist subconsciously within the population, and could therefore still present a complex barrier to e-bike uptake.

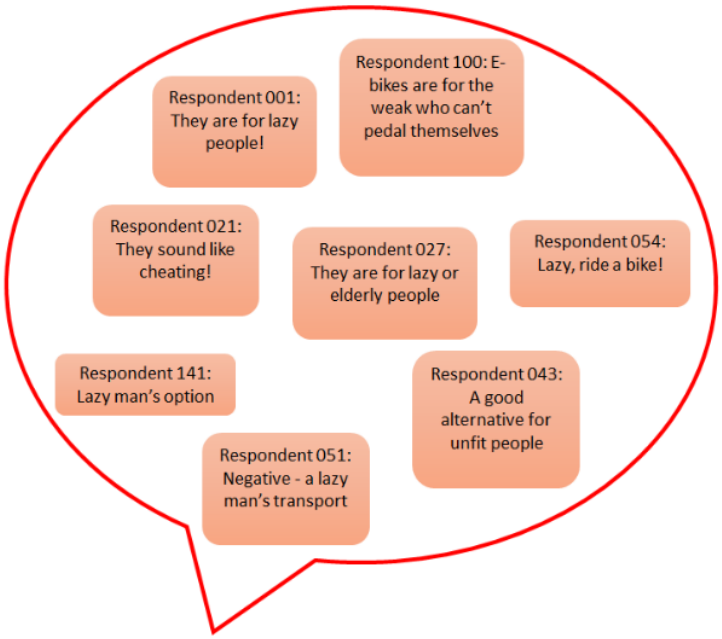


Figure 17: Negative social connotations associated with e-bike use

"I really liked it" - Interviewee one.

"It was great - faster and less effort than I expected" - Interviewee six.

"It really exceeded my expectations" - Interviewee eight.

When comparing how participant's views had changed before and after riding the e-bike, most participants felt more positively about e-bikes due to it being faster, more powerful, or easier to use than originally thought.

However, when it came to understanding whether participants were likely to try an e-bike again now that they had experienced the benefits, results were mixed. Some participants had previously not considered using an e-bike because they were unaware of e-bikes as a concept (interviewees one, four, six, seven and nine), and others had not considered e-bikes due to cost (interviewees three and five), the inconvenience of cycling with others (interviewee two), fear of cycling (interviewee eight) and because they use regular bikes (interviewees five and ten). Following the e-ride-along, several participants stated that they would use a dockless e-bike again, including interviewee ten who said they would use the dockless e-bike for "~20 minute trips, basically replacing a Tube trip", interviewee 1 who said that they "would definitely use it to commute" and interviewees two, six and seven who expressed an interest in using the dockless e-bike for leisure trips. It was noted that safety concerns could be a barrier to using dockless e-bikes for impromptu trips, as e-cyclists would have to "plan ahead to bring a helmet" (interviewee ten) if they were concerned about safety.

However, some participants were not interested in trying an e-bike again; interviewee nine because they used a regular bike for commuting and leisure trips, and interview four was unsure because "it wouldn't take the place of a traditional bike and I don't really think it takes the place of a car - it is just so niche". Furthermore, when participants were asked whether they would consider buying an e-bike, the overall answer was negative. Interviewee ten said that they would not buy one "unless I get to the point of being so old and decrepit and that I need a bike that does half the work", with the negative perceptions of e-bikes creeping in again. When asked why, cost was the most frequently quoted reason.

4.5 Implications for MLP studies

Findings from this study have interesting implications for the MLP framework. One of the main criticisms of the MLP as discussed in Chapter 2 is its lack of agency (Smith et al., 2005), which Geels et al. (2011) responds to by highlighting the inclusion of agency in the form of bounded rationality within MLP studies. Similar to the likes of Geels and Verhees (2011) who incorporate social movement theory into the MLP, this study has found that both aspects of TPB and the role of habit are important factors that influence individuals' travel choices. Therefore, it may be useful to develop and broaden the concept of agency within MLP studies to include these aspects of behaviour change theory, especially when assessing transitions relating to transport niches.

Secondly, results from the study survey showed that 37% of people were not at all aware or not very aware of e-bikes as a transport mode. In order for the e-bike niche to become more mainstream within the London transport regime, more people need to be aware of e-bikes and their advantages. This will help overcome the negative perceptions discussed above, and build social networks of e-bike users in order to expand the e-bike niche resource base (Geels, 2011). Popovich et al. (2014) highlighted the importance of social networks in promoting e-bike use, and interviewee three during the e-ride-along said that they would "always listen to [my] friends" when it came to transport choices over other transport-sector actors. Other London-specific challenges for the e-bike niche were noted during e-ride-alongs, including the reliability and efficiency of the public transport system, the lack of cycle infrastructure, and the strong cyclist identity discussed by the e-ride-along participants who regularly cycle. A lack of awareness by the general public alongside these regime characteristics may make it difficult for the e-bike niche to accumulate and challenge these elements that reinforce current regime lock-in.

Thirdly, aside from conforming to societal norms and beliefs within the public sphere, e-bikes would need to be integrated into relevant industries and markets where they would adapt to regulation and policy (Dueten et al., 1997). This would require sustained effort from a number of key actors within the niche and transport regimes, and further afield, in order to be successful. When e-ride-along participants were asked why they thought e-bikes weren't a common transport mode in London, answers included "because there hasn't been a big campaign to introduce them" (interviewee one), "I don't think there is enough cycling

infrastructure to support safe cycling, full stop" (interviewee four), and "it hasn't been promoted" (interviewee six). These answers amongst others highlight further barriers to e-bike use, this time institutional, that could be overcome by the co-ordinated work of transport actors to promote e-bikes.

Results of this study also go some way to suggesting what kind of interventions may be most valuable in order to encourage e-bike use. Figure 18 suggests that the two most likely ways of increasing e-bike use is through the use of dockless e-bikes and by providing a financial incentive for e-bike purchase, similar to recommendations by (Nocerino et al., 2016). Discussion from the e-ride-along also lends more cycle infrastructure to be included within these incentives.

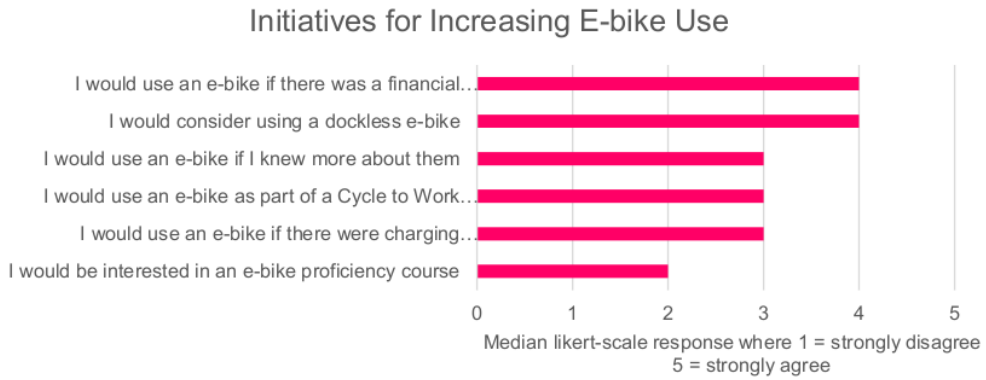


Figure 18: Median likert-scale responses for what could encourage people to use e-bikes

To expand on these interventions, this study has already shown that dockless bikes are a unique adaptation of the e-bike market that could help increase uptake. It is thought that the popularity of e-bikes in Europe compared to the UK is down to a simple locally or nationally-offered financial incentive which does not yet exist in the UK (The Bicycle Association, 2019). This, alongside high quality, safe bicycle infrastructure networks, is likely to further improve e-bikes' competitiveness with car and public transport (Plazier et al., 2017). These three interventions require integrated, sustained investment and collaboration between actors within the transport regime in order to be effective, including private companies such as Uber who provide dockless e-bikes, local transport authorities such as TfL, and multiple levels of government. It is the long-term work of these actors that will increase the chances of a transition to a sustainable transport system of which e-bikes could form a key part.

Chapter 5: Conclusion

The research question for this study was to explore to what extent e-bikes have the potential to transition from a transport niche to a mainstream transport mode in London within the context of the MLP in transition studies. This research aimed to examine the reasons as to why e-bike use in London is low compared to other cities in Europe, and what could be done to increase e-bike uptake. In London, a shift to sustainable transport modes as part of a carbon-neutral transport regime cannot happen without wider uptake of modes such as e-bikes amongst London's population. In order to understand whether the e-bike niche can accumulate, it is important that the main barriers to e-bike uptake are identified so that interventions and policy can be targeted in order to overcome them. The results of this research in relation to the study objectives outlined in Chapter 1 are outlined below.

5.1 Research Objective Conclusions

O1: to identify which behavioural factors influence Londoners' travel mode choices

When examining which factors may have the strongest influence on travel mode choice, rational factors such as time and cost were important for Londoners, especially for commuting trips. Elements of TPB such as PBC were important for cycling and driving trips, however social norms were not as great an influence. The role of habit was notable for survey respondents and e-ride-along participants which highlights the importance of considering habit within behaviour change theories such as TPB. Habitual associations were especially strong for commuting trips which suggests e-bikes may be more likely to be used for leisure trips. However, testing out an e-bike could arguably be used as an effective way to disrupt habitual commuting patterns, although a prolonged trial period may be more effective at facilitating longer-term change in travel choices. Although rational factors do influence travel choice, non-rational elements also play a role, and therefore the concept of agency within the MLP could be expanded to encapsulate this.

O2: to understand which barriers to e-bike use are most prevalent in London

Reflecting the literature (e.g. Popovich et al., 2014), the main barriers to e-bike use in London were found to be cost, safety and negative social stigma. This study develops these barriers further by highlighting their increasingly complex and multidimensional nature due to the introduction of dockless e-bikes. For example, the barrier of cost now not only refers to the

upfront cost of buying an e-bike, but also the cost of hiring a dockless e-bike for a trip. Although some safety issues inherent to the e-bike were raised such as the unexpected power of the initial boost, safety concerns were mainly focused on a lack of dedicated cycle infrastructure in London, similar to Astegiano et al. (2015). Generally, it was agreed that more bike-only spaces should be provided to allow cyclists and e-cyclists to feel comfortable and safe. Higher levels of regular cycling are also likely to help reduce the barrier of safety. Negative social stigma seemed to be subconsciously widespread amongst the survey responses and e-ride-along participant comments, however this did not take away from the overall positive experience of the e-ride-alongs. Identification of these barriers means that niche actors within the e-bike field can better target interventions to aspects currently preventing a wider transition to e-bike use.

O3: to explore whether the common perceptions of e-bikes from non-e-bike users vary between demographic groups

Similar to Heinen et al. (2010), it was found that perceptions of e-bikes did vary between demographic groups, and differing significance was placed on the barriers to e-bike use based on both gender and age. It was interesting to note that these differences didn't necessarily correlate to whether people were more aware of e-bikes, showing that perceptions may be down to deeper contextual influences relating to demographics rather than familiarity with the e-bike concept. As the e-bike niche accumulates, understanding the perceptions of different demographics can enable policy to be tailored to specific segments of the population so that more targeted policy interventions can be made (Anable, 2005). Future studies of attitudes towards e-bikes by gender and age should incorporate a larger and broader sample size in order for conclusions to be more representative and informed.

O4: to assess to what degree e-ride-along participant's attitudes towards e-bikes change before and after riding one

On the whole, e-ride-along participants found the e-bike experience more positive than they had expected, which shows that it is important that the benefits of e-bikes to be experienced by more people in order for the niche to accumulate (Fyhri et al., 2017). However, it is unclear whether this e-bike experience will translate into more dockless e-bike trips being taken. The impracticality of needing to carry a helmet if concerned about safety alongside the sporadic availability of dockless e-bike technology across London are both barriers to greater dockless e-bike use. The current transport system lock-in experienced by many participants due to the efficiency of the public transport system and the 'convenience' of car travel in

outer London will likely require more widespread introduction of dockless e-bike technology in order to be destabilised. Generally, the e-ride-along experience did not make e-ride-along participants want to buy an e-bike.

5.2 Further research

This research aimed to explore to what extent e-bikes have the potential to transition from a niche technology to a mainstream transport mode. The empirical results of this study have shown that there are promising signs that the e-bike niche has the potential to gain momentum and break into the current transport regime, however there are significant cultural and institutional barriers that must be overcome in order for this to happen. This will require heavy investment and momentum from a range of cross-disciplinary system actors. This study has introduced a new element into the ride-along methodology which facilitated thorough discussion and insight into experiencing an e-bike for the first time, invaluable for a study of this nature. This research has also tackled a key criticism of the MLP and provided clear recommendations for future MLP case study development. Looking at sustainable transitions driven by the niche level on a wider scale, this study has shown that experience of the niche technology first-hand is important if it to become socially and culturally accepted.

Study limitations include that due to the sampling strategy employed and the comparatively low levels of car use in London compared to other cities, the study could not conclude on certain aspects of potential e-bike benefits such as the potential for e-bikes to replace car trips. This research topic is generally still under-researched, and would benefit from further focus. Future research could also benefit from utilising a range of ages more representative of the population of London as a whole. Furthermore, replicating this study elsewhere in the UK, perhaps in a city with greater car use and less public transport use, may draw different conclusions.

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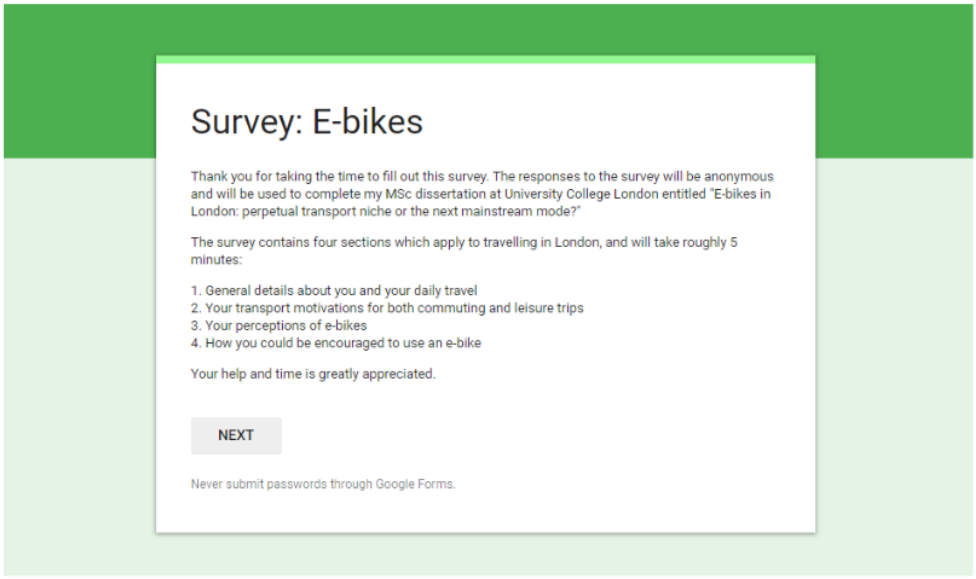
s bike schemes? Available at:

Appendix A: Survey



Section 1

- Age: Under 18, 18-24, 25-34, 35-44, 45-54, 55-64, or Over 65
- Gender: Female, Male, Prefer not to say, or Other
- London Borough of Residence
- How many cars do you have in your household? 0, 1, or 2 or more
- How frequently do you travel by car in London, either as a driver or passenger?
  Never, a few times per year, a few times per month, a few times per week, or daily
- How frequently do you travel by train, tube or bus in London?
  Never, a few times per year, a few times per month, a few times per week, or daily
- How frequently do you travel by walking or cycling in London?
  Never, a few times per year, a few times per month, a few times per week, or daily
- Which main transport mode do you use most frequently for commuting trips in London?
  Car, bus, tube, train, walk, cycle, e-bike, taxi/private hire, or Other
- Which main transport mode do you use most frequently for leisure trips in London?
  Car, bus, tube, train, walk, cycle, e-bike, taxi/private hire, or Other

Section 2

	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
When commuting, my preferred transport mode is the cheapest way to get to my destination					
For commuting trips, I have always travelled using my preferred transport mode					
When commuting, my preferred transport mode makes me feel in control of my trip					
When commuting, I use my preferred transport mode automatically without giving it too much thought					
When commuting, my preferred transport mode boosts my social status					
When commuting, I choose my preferred transport mode because it's what my friends do					
When commuting, my preferred transport mode helps me feel relaxed and stress free					
When commuting, my preferred transport mode is the quickest way I can get to my destination					
When commuting, my preferred transport mode is good for the environment					
When commuting, my preferred transport mode helps to improve my health and fitness					
For leisure trips, my preferred transport mode helps to improve my health and fitness					
For leisure trips, my preferred transport mode is the cheapest way to get to my destination					
For leisure trips, I use my preferred transport mode automatically without giving it too much thought					
For leisure trips, I have always travelled using my preferred transport mode					
For leisure trips, my preferred transport mode is good for the environment					
For leisure trips, my preferred transport mode boosts my social status					
For leisure trips, my preferred transport mode makes me feel in control of my trip					
For leisure trips, I choose my preferred transport mode because it's what my friends do					
For leisure trips, my preferred transport mode helps me feel relaxed and stress free					
For leisure trips, my preferred transport					

mode is the quickest way I can get to my destination					

Section 3

An e-bike can be defined as a bike with an integrated electric motor which can be used for propulsion. E-bikes are fully legal in the UK as long as the rider is over 14. The electric motor assists the rider up to speeds of 15.5mph, and the battery requires regular charging in order to travel over longer distances.

Pictures of e-bikes are included below for reference.

- How familiar are you with e-bikes as a travel mode?
  Not at all familiar, not very familiar, neutral, quite familiar, or extremely familiar
- What are your initial impressions, positive or negative, of e-bikes as a transport mode?
  _____
- How aware are you that Uber and Lime have recently launched dockless e-bikes in London?
  Not at all aware, not very aware, neutral, quite aware, extremely aware

	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
E-bikes are expensive					
E-bikes are a sustainable transport mode					
E-bikes are safer than regular bikes					
E-bikes are mainly used for recreational riding					
E-bikes are at greater risk of theft than regular bikes					
E-bikes can help to improve fitness					
E-bikes have a negative social stigma					
E-bikes are cheaper than running a car					
E-bikes are faster than public transport					
E-bikes are 'cheating'					
E-bikes would be useful for hilly journeys					
E-bikes would help to reduce my carbon footprint					

Section 4

	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
I would use an e-bike if there was a financial incentive					
I would use an e-bike if my friends did					
I would use an e-bike if I knew more about them					
I would consider using a dockless e-bike					
I would use an e-bike as part of a Cycle to Work scheme					
I would be interested in an e-bike proficiency course					
I would use an e-bike if there were regular charging facilities at my place of work					
I would use an e-bike if it meant I was going to save money on transport in the medium-long term					
I would be interested in finding out more about e-bikes					
Is there anything else you can think of that would encourage you to buy or use an e-bike?					

Appendix B: E-ride-alongs

The red arrow above signifies the meeting point, and Quietway 2 was used for the E-ride-alongs. E-ride-along participants were sent the interview format prior to meeting, alongside the location and a link explaining the concept of dockless e-bikes. Participants were also advised to bring a helmet for safety reasons.

E-ride-along questions

Introduce myself and my research including the research question
Explain that I am interested to learn about the interviewee's views, experiences and feelings in relation to the research question without passing judgement
Explain the interview format
Emphasise that the interview is confidential and confirm informed consent. Explain that the interview can be stopped at any time
Check that they are happy to be recorded
Commence sit-down interview
1. Tell me a bit about your travel patterns in London when commuting (distance, route, how many days per week, to what locations)
2. Tell me a bit about your travel patterns in London for leisure trips (distance, route,

how many days per week, to what locations)
3. How long have you been travelling this way for commuting and leisure?
4. Have you ever considered changing this for commuting trips, and why?
5. Have you ever considered changing this for leisure trips, and why?
6. Why did you choose to start travelling this way for both commuting and leisure trips?
7. What is the experience like for both commuting and leisure trips?
8. Is there anything about either your commuting or leisure trips that you'd change?
9. To what extent do you think these choices are an automatic routine?
10. What do you think your friends would say about your travel habits? Do you think this would make you consider changing your behaviour?
11. What is important to you when you travel around London generally?
12. To what extent do you feel in control of your journey when travelling for commuting and leisure trips?
13. To what extent does the environment, climate change or sustainability factor into your travel choices?
14. To what extent do you feel that the way you travel around London has an effect on how you feel day to day, either positively or negatively1?
15. How do you feel about cycling in London?
16. What do you think the main barriers are to cycling in London?
At this point interviewees will be read a short description of an e-bike and shown a picture
17. Do you have any questions about e-bikes before we continue?
18. To what extent are you aware of e-bikes as a transport mode?
19. Have you ever considered using an e-bike before and why/why not?
20. Do you think any of the barriers to regular cycling that you mentioned above could be overcome by using an e-bike?
21. What are your first impressions of e-bikes as a transport mode? (how suitable are they for travelling in London, what do you think the main user demographic is, how fast do you think they are, how heavy do you think they are, how do you think they look, what type of journey might they be used for?)
22. What kind of effect do you think an e-bike has on fitness levels?
23. How do you think the cost of buying and running an e-bike compares to using a car or public transport in London?
24. How do you feel about e-bikes in terms of how sustainable they are?
25. What do you think your friends would say if you bought or regularly used an e-bike?
26. E-bikes are very popular in the Netherlands/China. Why do you think they are not as popular in London?
27. Do you think e-bikes are more suitable for use in London than regular bikes? Why/why not?
28. What would need to change in order for you to start using an e-bike?
Commence e-ride-along
29. What is your initial impression of riding the e-bike, and how does it compare to

before riding one? (In terms of speed, weight, visuals, ease of use, level of fun)
30. How do you feel when you are riding it?
31. How does the experience differ to that of a regular bike?
32. To what extent do you think London's infrastructure is suitable for an e-bike? How could it be improved?
33. If you were to use an e-bike like this, what kind of trip might you use it for? (purpose, length)
34. Would you recommend an e-bike to a friend, and why?
35. Do you feel more inclined to try out an e-bike again now that you've tried one once?
36. Now that you've tried an e-bike, are you likely to consider buying one?
37. Who do you think has most influence on your travel choices? (friends, firms, companies, government)
38. How could you be encouraged to use or buy an e-bike?
39. Why do you think getting more people to use sustainable transport in London is such a big challenge?
40. To what extent do you think dockless e-bike initiatives such as this one will help encourage e-bike use?
41. Is there anything else you'd like to add?
42. Can I contact you again if I need to follow up on anything?
Thank you very much for your time.
Finish e-ride-along

Appendix C: Risk Assessment

RISK ASSESSMENT FORM
FIELD / LOCATION WORK

UCL

The Approved Code of Practice - Management of Fieldwork should be referred to when completing this form
http://www.ucl.ac.uk/estates/safetynet/guidance/fieldwork/acop.pdf

DEPARTMENT/SECTION : BARTLETT SCHOOL OF PLANNING
LOCATION(S) LONDON, UK
PERSONS COVERED BY THE RISK ASSESSMENT Kathryn Elsby

BRIEF DESCRIPTION OF FIELDWORK Cycling interviews using dockless e-bikes

Consider, in turn, each hazard (white on black). If **NO** hazard exists select **NO** and move to next hazard section.
If a hazard does exist select **YES** and assess the risks that could arise from that hazard in the risk assessment box.
Where risks are identified that are not adequately controlled they must be brought to the attention of your Departmental Management who should put temporary control measures in place or stop the work. Detail such risks in the final section.

ENVIRONMENT — **The environment always represents a safety hazard. Use space below to identify and assess any risks associated with this hazard**

e.g. location, climate, terrain, neighbourhood, in outside organizations, pollution, animals.

Examples of risk: adverse weather, illness, hypothermia, assault, getting lost.
Is the risk high / medium / low ?

Adverse weather (rain, sun, storms). Risk: low
Getting lost. Risk: low

CONTROL MEASURES — **Indicate which procedures are in place to control the identified risk**

- ☐ work abroad incorporates Foreign Office advice
- ☐ participants have been trained and given all necessary information
- ☐ only accredited centres are used for rural field work
- ☒ participants will wear appropriate clothing and footwear for the specified environment
- ☐ trained leaders accompany the trip
- ☐ refuge is available
- ☐ work in outside organisations is subject to their having satisfactory H&S procedures in place
- ☒ OTHER CONTROL MEASURES: please specify any other control measures you have implemented:

Interviewer is familiar with route to be taken.

EMERGENCIES — **Where emergencies may arise use space below to identify and assess any risks**

e.g. fire, accidents

Examples of risk: loss of property, loss of life

Injury due to fall or collision with traffic. Risk: low

CONTROL MEASURES — **Indicate which procedures are in place to control the identified risk**

- ☐ participants have registered with LOCATE at http://www.fco.gov.uk/en/travel-and-living-abroad/
- ☐ fire fighting equipment is carried on the trip and participants know how to use it
- ☐ contact numbers for emergency services are known to all participants
- ☒ participants have means of contacting emergency services
- ☐ participants have been trained and given all necessary information
- ☐ a plan for rescue has been formulated, all parties understand the procedure
- ☐ the plan for rescue /emergency has a reciprocal element
- ☐ OTHER CONTROL MEASURES: please specify any other control measures you have implemented:

Interviewees will be advised to wear helmets.

FIELDWORK **1** May 2010

EQUIPMENT	Is equipment used?	Yes	If 'No' move to next hazard If 'Yes' use space below to identify and assess any risks
e.g. clothing, outboard motors.	Examples of risk: inappropriate, failure, insufficient training to use or repair, injury. Is the risk high / medium / low ?		

Dockless e-bikes will be used.
Injury due to fall or collision with traffic. Risk: low.

CONTROL MEASURES	Indicate which procedures are in place to control the identified risk
☐	the departmental written Arrangement for equipment is followed
☐	participants have been provided with any necessary equipment appropriate for the work
☐	all equipment has been inspected, before issue, by a competent person
☒	all users have been advised of correct use
☐	special equipment is only issued to persons trained in its use by a competent person
☐	OTHER CONTROL MEASURES: please specify any other control measures you have implemented:

Interviewees will be advised to wear helmets.
The majority of the route will be cycled on a Quietway which is a traffic calmed route.
Interviewees will be sent information about dockless e-bikes in advance.

LONE WORKING	Is lone working a possibility?	No	If 'No' move to next hazard If 'Yes' use space below to identify and assess any risks
e.g. alone or in isolation lone interviews.	Examples of risk: difficult to summon help. Is the risk high / medium / low?		

CONTROL MEASURES	Indicate which procedures are in place to control the identified risk
☐	the departmental written Arrangement for lone/out of hours working for field work is followed
☐	lone or isolated working is not allowed
☐	location, route and expected time of return of lone workers is logged daily before work commences
☐	all workers have the means of raising an alarm in the event of an emergency, e.g. phone, flare, whistle
☐	all workers are fully familiar with emergency procedures
☐	OTHER CONTROL MEASURES: please specify any other control measures you have implemented:

ILL HEALTH	**The possibility of ill health always represents a safety hazard. Use space below to identify and assess any risks associated with this Hazard.**
e.g. accident, illness, personal attack, special personal considerations or vulnerabilities.	Examples of risk: injury, asthma, allergies. Is the risk high / medium / low? Accident due to fall or collision with traffic. Risk: low.

CONTROL MEASURES **Indicate which procedures are in place to control the identified risk**

- ☐ an appropriate number of trained first-aiders and first aid kits are present on the field trip
- ☐ all participants have had the necessary inoculations/ carry appropriate prophylactics
- ☒ participants have been advised of the physical demands of the trip and are deemed to be physically suited
- ☐ participants have been adequate advice on harmful plants, animals and substances they may encounter
- ☐ participants who require medication have advised the leader of this and carry sufficient medication for their needs
- ☐ OTHER CONTROL MEASURES: please specify any other control measures you have implemented:

Interviewees will be advised to wear helmets.
The majority of the route will be cycled on a Quietway which is a traffic calmed route.

TRANSPORT	**Will transport be required**	**NO** ☐	**Move to next hazard**
		YES ☐	**Use space below to identify and assess any risks**
e.g. hired vehicles	Examples of risk: accidents arising from lack of maintenance, suitability or training Is the risk high / medium / low?		

CONTROL MEASURES **Indicate which procedures are in place to control the identified risk**

- ☐ only public transport will be used
- ☐ the vehicle will be hired from a reputable supplier
- ☐ transport must be properly maintained in compliance with relevant national regulations
- ☐ drivers comply with UCL Policy on Drivers http://www.ucl.ac.uk/hr/docs/college_drivers.php
- ☐ drivers have been trained and hold the appropriate licence
- ☐ there will be more than one driver to prevent driver/operator fatigue, and there will be adequate rest periods
- ☐ sufficient spare parts carried to meet foreseeable emergencies
- ☐ OTHER CONTROL MEASURES: please specify any other control measures you have implemented:

DEALING WITH THE PUBLIC	**Will people be dealing with public** ☐	**If 'No' move to next hazard** **If 'Yes' use space below to identify and assess any risks**
e.g. interviews, observing	Examples of risk: personal attack, causing offence, being misinterpreted. Is the risk high / medium / low?	

CONTROL MEASURES **Indicate which procedures are in place to control the identified risk**

- ☐ all participants are trained in interviewing techniques
- ☐ interviews are contracted out to a third party
- ☐ advice and support from local groups has been sought
- ☐ participants do not wear clothes that might cause offence or attract unwanted attention
- ☐ interviews are conducted at neutral locations or where neither party could be at risk
- ☐ OTHER CONTROL MEASURES: please specify any other control measures you have implemented:

WORKING ON OR NEAR WATER

Will people work on or near water? ☐

If 'No' move to next hazard
If 'Yes' use space below to identify and assess any risks

e.g. rivers, marshland, sea.

Examples of risk: drowning, malaria, hepatitis A, parasites. Is the risk high / medium / low?

CONTROL MEASURES **Indicate which procedures are in place to control the identified risk**

- ☐ lone working on or near water will not be allowed
- ☐ coastguard information is understood; all work takes place outside those times when tides could prove a threat
- ☐ all participants are competent swimmers
- ☐ participants always wear adequate protective equipment, e.g. buoyancy aids, wellingtons
- ☐ boat is operated by a competent person
- ☐ all boats are equipped with an alternative means of propulsion e.g. oars
- ☐ participants have received any appropriate inoculations
- ☐ OTHER CONTROL MEASURES: please specify any other control measures you have implemented:

MANUAL HANDLING (MH)

Do MH activities take place? ☐

If 'No' move to next hazard
If 'Yes' use space below to identify and assess any risks

e.g. lifting, carrying, moving large or heavy equipment, physical unsuitability for the task.

Examples of risk: strain, cuts, broken bones. Is the risk high / medium / low?

CONTROL MEASURES **Indicate which procedures are in place to control the identified risk**

- ☐ the departmental written Arrangement for MH is followed
- ☐ the supervisor has attended a MH risk assessment course
- ☐ all tasks are within reasonable limits, persons physically unsuited to the MH task are prohibited from such activities
- ☐ all persons performing MH tasks are adequately trained
- ☐ equipment components will be assembled on site
- ☐ any MH task outside the competence of staff will be done by contractors
- ☐ OTHER CONTROL MEASURES: please specify any other control measures you have implemented:

SUBSTANCES	Will participants work with substances		If 'No' move to next hazard If 'Yes' use space below to identify and assess any risks
e.g. plants, chemical, biohazard, waste	Examples of risk: ill health - poisoning, infection, illness, burns, cuts. Is the risk high / medium / low?		

CONTROL MEASURES	Indicate which procedures are in place to control the identified risk
☐	the departmental written Arrangements for dealing with hazardous substances and waste are followed
☐	all participants are given information, training and protective equipment for hazardous substances they may encounter
☐	participants who have allergies have advised the leader of this and carry sufficient medication for their needs
☐	waste is disposed of in a responsible manner
☐	suitable containers are provided for hazardous waste
☐	OTHER CONTROL MEASURES: please specify any other control measures you have implemented:

OTHER HAZARDS	Have you identified any other hazards?		If 'No' move to next section If 'Yes' use space below to identify and assess any risks
i.e. any other hazards must be noted and assessed here.	Hazard: Risk: is the risk		

CONTROL MEASURES	Give details of control measures in place to control the identified risks

Have you identified any risks that are not adequately controlled?		
NO	☒	Move to Declaration
YES	☐	Use space below to identify the risk and what action was taken

Is this project subject to the UCL requirements on the ethics of Non-NHS Human Research? No

If yes, please state your Project ID Number

For more information, please refer to: http://ethics.grad.ucl.ac.uk/

DECLARATION

The work will be reassessed whenever there is a significant change and at least annually. Those participating in the work have read the assessment.

Select the appropriate statement:

☒ I the undersigned have assessed the activity and associated risks and declare that there is no significant residual risk

☒ I the undersigned have assessed the activity and associated risks and declare that the risk will be controlled by the method(s) listed above

NAME OF SUPERVISOR Astrid Wood (signed by digital signature)

SIGNATURE OF SUPERVISOR DATE 9 August 2019